



Short Communication

# Gender-differential associations between attention deficit and hyperactivity symptoms and youth health risk behaviors



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Received Dec 7, 2018; received in revised form Mar 19, 2019; accepted Jun 5, 2019

Available online 15 June 2019

## 1. Introduction

Attention deficit and hyperactivity disorder (ADHD) is one of the common developmental disorders that generally receives clinical attention at learning ages, and some symptoms may persist in young adulthood.<sup>1</sup> Past research has demonstrated a consistent association between ADHD and youth health risk behaviors (e.g., cigarette smoking), which often develop during adolescence and contribute to early morbidity and mortality among young adults.<sup>2</sup> However, ADHD symptoms are not routinely screened in

adolescents and emerging adults during their visits to healthcare providers.<sup>3</sup> The six-item Adult Self-Report Scale (ASRS-6) for ADHD has been validated in the young population for screening purposes.<sup>4</sup> This short form is time-saving and also provides a comparable predictivity of ADHD diagnosis as that of the original long version.<sup>5</sup> Although accumulating evidence has demonstrated the association between ADHD symptoms and youth health risk behaviors, this issue has scarcely been explored in the Taiwanese youth population.<sup>6</sup> Therefore, this study was conducted to validate the psychometric property of the

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Chinese version of ASRS-6 and examine the gender-stratified association between ADHD symptoms and youth health risk behaviors.

## 2. Methods

Individuals aged 15–22 years with no mental or major physical illness were recruited voluntarily through research announcements.<sup>7</sup> The participants provided consent only after completing the questionnaires. The entire study procedure was approved by the Institutional Review Board of the National Cheng Kung University Hospital. The primary outcomes were youth health behaviors that were evaluated using the youth health behavior checklist,<sup>5</sup> which included substance use (i.e., alcohol and tobacco use), deviant behaviors, unsafe practices, internet addiction, sleep problems/tiredness, unprotected sex, and victimization by bullying. The responses were dichotomized (yes and no) in the analysis. ADHD symptoms were rated on a 4-point Likert scale using ASRS-6, which comprises four items on inattention and two items on hyperactivity. Aligned with the scoring method published previously,<sup>4</sup> the original scores on each item were dichotomized and then summed up. A sum score of  $\geq 4$  may suggest the presence of ADHD symptoms.<sup>4</sup>

Confirmatory factor analysis (CFA) was used to examine the psychometric property of ASRS-6. A two-factor model was tested using the comparative fit index (CFI  $> 0.90$ ), the root mean square error of approximation (RMSEA  $< 0.08$ ), and the standardized root mean square residual (SRMR  $< 0.08$ ) indicating the goodness-of-fit.<sup>8</sup> In addition, logistic regression analyses were performed to examine the association between ADHD symptoms and health risk behaviors. Model 1 tested the association using different cut-off sum scores of ASRS-6. Model 2 evaluated the association between the original scores of inattention and hyperactivity domains and health-risk behaviors. Statistical analyses were performed by RStudio (v1.1.456) using the LAVAAN package (<http://lavaan.ugent.be/>).

## 3. Results

The study sample comprised 492 (51% males) participants with a mean age of 20.01 ( $\pm 1.41$ ) years (Table S1). CFA revealed a suboptimal model fit (CFI = 0.83, RMSEA = 0.1, and SRMR = 0.07) of the two-factor structure, which included the components inattention ( $\alpha = 0.63$ ) and hyperactivity ( $\alpha = 0.50$ ) (Fig. S1). In model 1, ADHD symptomatology based on ASRS-6  $\geq 4$  (41.4% in males and 19.5% in females) correlated with deviant behavior (odds ratio 2.07 [95% confidence interval 1.09–3.99]), internet addiction (1.96 [1.10–3.56]), and victimization by bullying (2.01 [1.10–3.71]) in males and sleep problems/tiredness (2.51 [1.27–5.25]) in females (Table 1). In the sensitivity analysis, ADHD symptomatology based on a higher cut-off of ASRS-6  $\geq 5$  (19.5% in males and 13.3% in females) was only consistently associated with sleep problems/tiredness (3.10 [1.21–9.58]) in females. A separating effect of inattention and hyperactivity components was observed in model 2, wherein hyperactivity was associated with deviant behavior

(1.39 [1.12–1.73]), unsafe practice (1.29 [1.06–1.60]), internet addiction (1.31 [1.08–1.60]), sleep problems/tiredness (1.35 [1.13–1.64]), and victimization by bullying (1.27 [1.04–1.56]) in males; in contrast, hyperactivity was associated with sleep problems/tiredness (1.68 [1.34–2.16]) and victimization by bullying (1.55 [1.26–1.94]). Inattention did not reveal any relationship with risk behavioral outcomes in both genders.

## 4. Discussion

By using the ASRS-6, we detected a higher prevalence of ADHD symptoms than previously reported in youth.<sup>9</sup> This discrepant result may be due to methodological differences or other possibilities that make the questionnaire-based screening sensitive to detect subthreshold ADHD symptoms. We also observed that hyperactivity was preferentially associated with health risk behaviors in males but not in females. The differential effects may be caused due to a generally lower frequency of health risk behaviors found in females. Furthermore, hyperactivity was associated with sleep problems and victimization by bullying in both genders, which may require attention from healthcare providers.

CFA revealed that the factorial model fit of ASRS-6 was somehow unsatisfactory. We assumed that the development of ASRS-6 was originally based on its utility, rendering its psychometric properties less fit for a stringent factorial structure. A higher cut-off of ASRS-6 may not necessarily differentiate the severity in ADHD symptoms, which was an assumed explanation for the lack of significant associations between ADHD symptoms and health risk behaviors in males. We must take these limitations into account when interpreting the results. Another limitation is the sampling size and method, which requires a larger participation size and a systemic sampling strategy before making a generalization. For example, our research emphasized on screening ADHD symptoms among the generally healthy youth population and excluded those with comorbid psychiatric or neurodevelopmental disorders. The estimates for the association between ADHD symptoms and health risk behaviors may be different in patients with these comorbidities. Moreover, the analyzed health risk behaviors were largely impulsiveness-related. Inattention-related behaviors, such as careless driving, were not included in this study but are warranted of further investigation to fully capture the behavioral impacts of ADHD symptoms in youth.

In conclusion, ADHD symptoms are not uncommon but might be overlooked in the Taiwanese adolescents and emerging adults. Hyperactivity is gender-differentially associated with their health-compromising behaviors. Our findings emphasized the need for scrutinizing ADHD symptoms when consulting with this age group, particularly those with behavioral issues. ADHD symptoms based on an ASRS-6 score  $\geq 4$  were significantly associated with several youth health risk behaviors. However, further diagnostic interviews may be required to confirm the severity and decide the management of ADHD.

**Table 1** Association between ADHD and health compromising behaviors in youths.

	Model 1	Model 2	
	Cutoff $\geq 4$	Inattention	Hyperactivity
	OR (95%CI)	OR (95%CI)	OR (95%CI)
<b>Male</b>			
Substance use	1.55 (0.76, 3.24)	1.14 (0.98, 1.32)	1.06 (0.84, 1.34)
Deviant behavior	2.07 (1.09, 3.99)*	1.08 (0.95, 1.22)	1.39 (1.12, 1.73)**
Unsafe practice	1.37 (0.73, 2.57)	1.09 (0.96, 1.23)	1.29 (1.06, 1.60)*
Internet addiction	1.96 (1.10, 3.56)*	1.02 (0.91, 1.14)	1.31 (1.08, 1.60)**
Sleep problem/tiredness	1.68 (0.98, 2.90)	1.07 (0.96, 1.19)	1.35 (1.13, 1.64)**
Unprotected sex	1.52 (0.88, 2.64)	1.1 (0.99, 1.23)	1.15 (0.96, 1.38)
Victimization of bullying	2.01 (1.10, 3.71)*	1.07 (0.95, 1.21)	1.27 (1.04, 1.56)*
<b>Female</b>			
Substance use	0.91 (0.46, 1.83)	0.98 (0.85, 1.12)	1.11 (0.89, 1.39)
Deviant behavior	2.27 (0.92, 5.55)	1.15 (0.95, 1.40)	1.32 (1.00, 1.75)
Unsafe practice	1.54 (0.74, 3.10)	1.10 (0.95, 1.28)	1.00 (0.79, 1.26)
Internet addiction	1.37 (0.74, 2.59)	1.02 (0.90, 1.16)	1.13 (0.93, 1.38)
Sleep problem/tiredness	2.51 (1.27, 5.25)*	1.03 (0.91, 1.18)	1.68 (1.34, 2.16)***
Unprotected sex	0.79 (0.43, 1.46)	1.11 (0.98, 1.26)	0.88 (0.73, 1.07)
Victimization of bullying	1.71 (0.92, 3.16)	1.11 (0.98, 1.27)	1.55 (1.26, 1.94)***

\* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ .

ARSR-6 indicates the Adult Self-Report Scale for attention deficits and hyperactivity disorder, six-item version; OR, odds ratio; CI confidence interval.

All the regression models were stratified by gender and controlled for age, family structures, family economic status, and parental education.

## Conflict of interest

The author declares no conflicts of interest.

## Funding

This study was partly supported by the research grant from the Ministry of Science and Technology, Taiwan (105-2628-B-006 -010).

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.pedneo.2019.06.003>.